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MEMORANDUM

(Joint OSI/OSR)

The Performance and Deployment of the Tallinn Missile System

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TCS-7045/67

CENTRAL INTELLIGENCE AGENCY

INTELLIGENCE MEMORANDUM

The Performance and Deployment of the Tallinn Missile System

Summary

The Soviets are deploying the Tallinn air defense missile system widely throughout the Soviet Union. The number of identified complexes has reached 41, and the first few complexes probably are now operational. Ultimate operational deployment probably will reach about 100 complexes some time in 1971.

The conclusion that the role of the Tallinn system is to provide defense against an aerodynamic threat, rather than against ballistic missiles, has been strengthened by recent information on the physical characteristics of the major elements of the system and on the deployment pattern that has emerged as the program has gained momentum.

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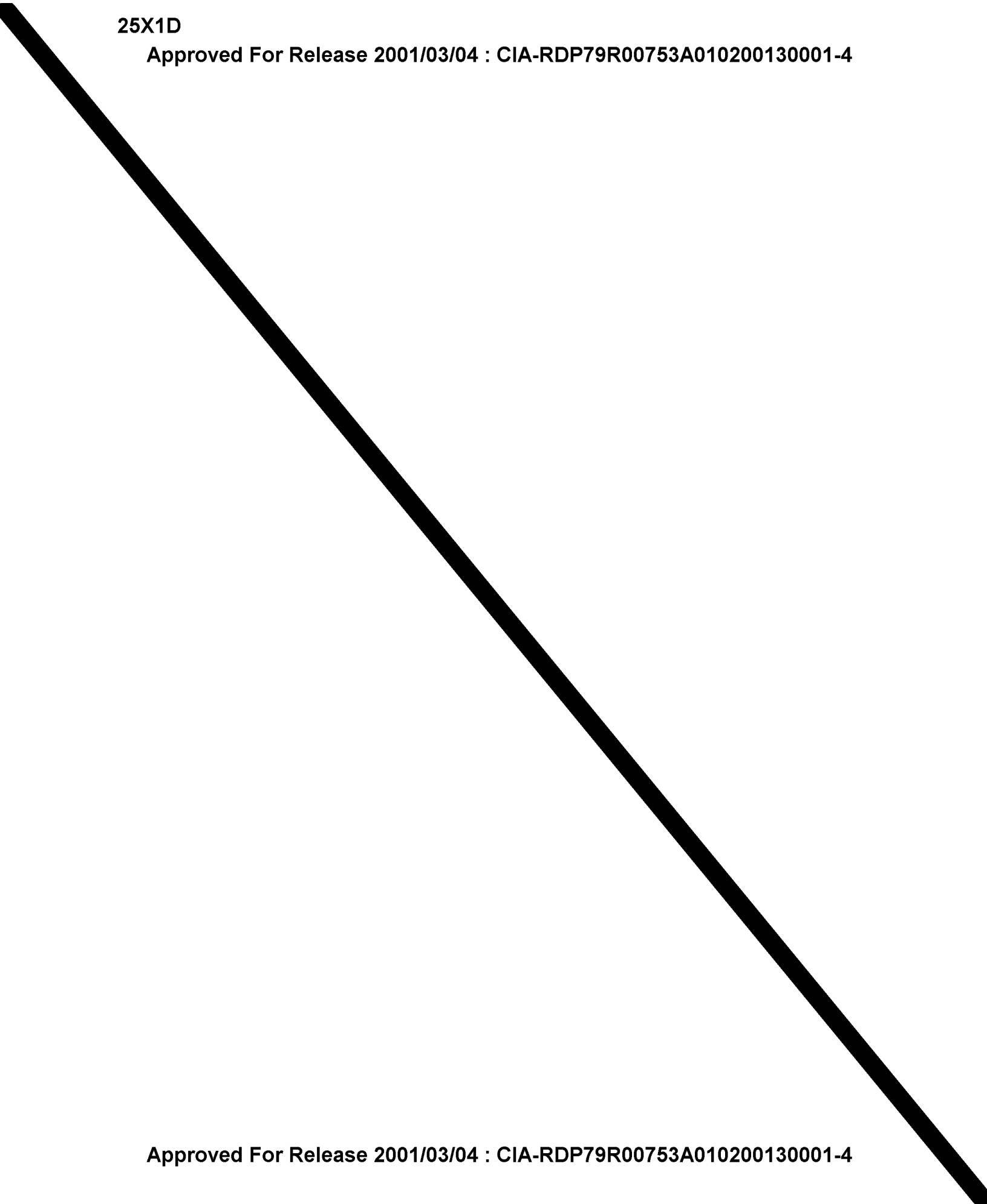
[redacted] The engagement radar is now known to employ several small reflectors in a configuration that indicates its design probably retains a number of features which have been present in the fire control radars associated with earlier Soviet SAM systems.

NOTE: This memorandum was produced by CIA. It was prepared jointly by the Office of Scientific Intelligence and the Office of Strategic Research and coordinated with the Office of National Estimates. The memorandum presents new information on the probable performance of the Tallinn system in an air defense role, as well as revised force level projections. It does not discuss in detail all of the factors supporting the basic judgment on the system's role, nor the requirements that led the Soviets to develop and deploy this system. These subjects have been discussed in previous publications.



25X1D [redacted] suggested the existence of two configurations of the missile, a review of all the evidence leads to the conclusion that there is only one. This configuration consists of a [redacted] sustainer section with delta wings and strap-on booster units. The presence and nature of the wings reveal a design for atmospheric operation against maneuvering targets. Calculated performance characteristics show the missile to be capable of intercepting targets at speeds up to Mach 3 as high as 100,000 feet at ranges of about 100 nm.

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Although the missile also appears capable of low-altitude intercepts, the effectiveness of the Tallinn system in such a role cannot be determined because the low-altitude capabilities of the engagement radar remain uncertain. [redacted]

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The Tallinn complexes appear to be a part of the total Soviet air defense network and to utilize its early warning facilities. Each complex includes the elements of a system needed to provide an impressive defense against aerodynamic targets at the range suggested by the observed deployment, about 75 nm.

Several aspects of the recent deployment also reinforce our view of the role of the Tallinn system. All of the newly deployed complexes, for instance, continue to follow a pattern consistent with SA-2 deployment. This pattern includes barrier defenses for the western USSR and point defense of high-priority targets throughout the country. [redacted]

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TCS-7045/67

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The Soviets have recently accelerated the rate of deployment of the system. Twelve complexes are known to have been started in the first half of 1967, compared with a total of 14 in all of 1966. In addition, the quickened pace of construction [redacted] at several new complexes suggests that the time required to bring each complex to operational status will be reduced from some two years to about 18 months.

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The deployment pattern [redacted] thus far suggests that the 100 complexes will consist of roughly 300 launch sites. If the recent start rate and construction pace are sustained, new complexes would continue to be started through 1969, and deployment of the entire operational force would be completed during 1971.

TCS-7045/67

New Deployment 25X1D

1. Eighteen new Tallinn system long-range SAM complexes have been [redacted] since early December 1966, twelve of which were started in the first half of 1967. This is almost double the rate of 25X1D [redacted] 1966 and clearly indicates an acceleration of the deployment program. The total known deployment is now 41 complexes, the first few of which are probably operational (see Figure 1).

2. Deployment of the Tallinn system is continuing for barrier defense of the European heartland and for point/area defense of strategic targets located throughout the USSR. Nine of the 25X1D [redacted] complexes are located in the barrier defenses being formed for the European heartland. Some of the new complexes, such as Kiev, Khabarovsk, and Chelyabinsk, are apparently for defense of the important industrial and military installations located within these areas. The complexes at the Kapustin Yar and Tyuratam Missile Test Ranges, defending research and development activities rather than urban-industrial areas, may be intended for use against reconnaissance by aircraft.

Configuration of Complexes

3. The new complexes, except the one at Kapustin Yar, will consist of three launch sites when completed. The Kapustin Yar complex, similar to one at the Sary Shagan Missile Test Center (SSMTC), contains just two launch sites. The first seven complexes constructed consist of five launch sites and 32 are three-site complexes. All future complexes are expected to contain three launch sites.

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[redacted]

System Performance

5. Sufficient information is now available on the major elements of the Tallinn system, particularly the engagement radar and the missile, to postulate in some detail how the system functions in the air defense role and to assess its probable
25X1D capabilities.

Radar

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[redacted] Indeed, it appears likely that the engagement radar is, in concept at least, a descendant of the guidance radars for the SA-1, the SA-2, and the SA-3 systems and that it does not represent a radical departure from the technological design concepts established throughout their development. Certain

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features which have emerged in the development of these radars are expected to be retained in the design of the engagement radar. These include:

a. An independent scanning system for target acquisition at longer ranges.

b. A track-while-scan system allowing the tracking of missiles and target in a common sector, at least in the mid-course and near-terminal phases of the engagement.

c. An ability to operate in noise and angle deception jamming environments.

d. The capability of an individual radar to guide several missiles to a single target.

e. The incorporation of clutter reduction techniques for operation against low-altitude targets.

7. In addition to these attributes, it is anticipated that the engagement radar will have a capability to operate against targets with smaller cross sections at longer ranges than its predecessors. The stringent requirements on tracking accuracy at longer ranges will probably require the incorporation of homing guidance on the missile.

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TCS-7045/67

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10. Such a scheme is consistent with the evidence at hand, but may not be a unique description of the operational concept of the engagement radar. It is not free of difficulties, particularly in the formation of a large enough scan sector to handle both missiles and target. Nevertheless, departures from this description are unlikely to affect greatly the contribution of the engagement radar to overall system performance.

Missile

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[redacted]

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[redacted] it is believed that only a single version of the Tallinn missile exists with the configuration being composed of an unbroken sustainer section to which are attached long, highly swept delta wings and four strap-on booster units. Such a configuration reveals an intended use within the atmosphere against maneuvering targets. The following points summarize the basis for this judgment as to configuration:

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[redacted]

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TCS-7045/67

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f. The use of the same launcher for two radically different missiles with attendant launcher/missile compatibility problems is highly unlikely.

g. Analysis has shown that a fully assembled delta wing missile (strap-on boosters attached) positioned on the launcher may well give the appearance of a clustered booster section, thus giving rise to the speculation of a second missile configuration.

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TCS-7045/67

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j. Only one type of missile transporter has been seen associated with the Tallinn System. An analysis of the load-bearing capability of this transporter shows that it would not be capable of transporting the weight estimated for the tandem stage missile (clustered boosters) but would handle the weight of the delta wing missile.

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Capabilities of the System

14. The delta-winged configuration with strap-on booster units appears to have formidable air defense capabilities.

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[redacted] estimates of total missile weight

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range from 18,000 to 22,500 pounds. Performance analysis based on several important assumptions indicates that if the sustainer of the Tallinn missile employs a liquid propulsion system and also has the capability of engine throttling, then the long-range capability of the system against

high-altitude targets could be extended to more than 100 nm while the missile is still in powered flight. At about 100,000 feet and at Mach 4, the missile in this mode would retain a 3g maneuver capability. Intercept during powered flight has been a characteristic of all earlier Soviet SAM systems. The use of a liquid fueled sustainer appears likely in view of the presence of two separate fuel storage areas at deployed complexes. This extended cruise range can be achieved by reducing thrust to equal drag at any given Mach number after flying a ballistic trajectory and then gradually pushing over to a chosen cruise altitude. This sort of boost-cruise propulsion mode is believed to be employed also by the AS-4 KITCHEN missile. The resulting performance estimate for the Tallinn missile carrying a warhead of about 1,000 pounds is similar to that estimated for the GRIFFON missile when used in the same operational mode. This may reflect a similar air defense role for the two missiles. Aerodynamic heating analysis shows that, for typical high-altitude missions, heating would pose no problem if the missile were fabricated from stainless steel or some comparable material in thicknesses commensurate with typical structural design practices.

15. When used in a possible low-altitude role, intercept range of the missile is, of course, limited by radar line of sight. With radar detection ranges of 28 and 40 nm for targets at 500 and 1,000 feet, respectively, a significant low-altitude intercept capability emerges. Minimum ranges (which occur when the targets are flying directly at the defensive complex) for the intercept of Mach 0.8 targets at these two altitudes are calculated to be 17.5 and 27 nm. However, the intercept range for offset targets such as those flying between two complexes in a barrier grows significantly. This effect is particularly important as intercept ranges under these circumstances establish the spacing requirements for complexes providing a barrier defense. For example, the maximum distance between two complexes that still provides a barrier defense against a Mach 0.8 target at 500 feet is calculated to be about 54 nm.

Current deployment suggests that the future separation between complexes will be about 60 nm, which easily allows a barrier defense against targets at 1,000 feet if not at 500 feet. Aerodynamic heating of the missile during low-altitude missions would not impose any greater constraint than in the high-altitude case.

16. The Soviet scheme of operation probably calls for the deployed complexes of the Tallinn system to receive target data first from the air defense early warning net. These data can be amplified by the complexes' own BACK NET radars when the target approaches to within about 250 nm. The BACK NET can then supply azimuth data quickly and with sufficient accuracy to enable the engagement radar to acquire its target rapidly. This should be the case even without the small active dish having to scan in azimuth. The associated SIDE NET height finding radar can provide elevation data which may be needed for nearer targets, including those at low altitudes whose elevation angle increases rapidly, if the 10-foot dish has only a limited elevation scan, as appears likely. Because of the slowly changing, low elevation angles of targets at long ranges, the SIDE NET might not be needed for initial acquisition but would be important to the threat assessment and assignment of targets penetrating the limits of system defense. [redacted]

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17. The engagement radar, based on its estimated capabilities, could easily acquire a target of one square meter cross section or more at such a range as to provide ample time for the intercept of a medium- to high-altitude target about 75 nm away - the defensive range indicated by the separation of adjacent complexes in current barrier deployment. Similarly, the missile, with the use of suitable materials, could reach targets at this distance in a cruise mode while still under powered flight.

18. The limited amount of information currently available on the engagement radar of the Tallinn system precludes any detailed delineation of its low-altitude capabilities. While the separation between the deployed sites along the barrier still appears to be too great to provide a full defense against aerodynamic threats as low as 500 feet, concern with low-altitude capability is evident [redacted] 25X1D 25X1D More detailed information about the radar will be required to permit an assessment of the low-altitude capability.

Deployment Aspects Bearing on System Role

19. The many similarities between the SA-2 system and Tallinn system - the configuration of the systems' components [redacted] 25X1D 25X1D 25X1D continue to suggest an air defense role. The major deviations in the Tallinn system deployment from the SA-2 deployment are the line of complexes extending from Leningrad to the Urals and the identification of barrier defenses earlier in the deployment program. A long-range SAM system is well suited for barrier defenses and priority probably has been given to this mode of deployment, particularly across the northern USSR where SAM defenses were previously nonexistent.

20. Another factor suggesting an air defense role for the Tallinn system and further supported by the new deployment is that several complexes are located so that ballistic missiles coming into their defended areas from the continental United States could not be seen by the known ballistic missile acquisition and early tracking radars. There are now a total of 13 complexes located too far east to benefit from data provided by the two types of large electronically steered radars (HEN HOUSE and DOG HOUSE) which might otherwise provide early warning and initial tracking information.

Projected Deployment and Force Levels

21. Eighteen complexes (including the three around Leningrad) now form part of the European USSR barrier defense which extends from Feodosiya on the Black Sea coast to Chernovtsy near the Rumanian border, to the Baltic Coast and Leningrad, and then eastward to the Urals. The distances between the Liepaya and Ventspils complexes (less than 45 nm) and between the Neya and Sharya complexes (less than 50 nm) indicate that several more complexes will be constructed between other existing barrier complexes. The separations between these complexes are also consistent with the distances between the complexes deployed for area defense at Moscow and in the Urals. On the basis of this new deployment data, it is believed that some 30 additional complexes will be required to provide a continuous barrier defense for the southern, western, and northern European heartland. Deployment of the Tallinn system for point defense of important targets along the Volga River such as Kazan, Kuybyshev, Saratov, and Kamyshin will also provide an eastern barrier defense for the European heartland.

22. The reason for deployment of the Tallinn system complex at Yuzhno-Sakhalinsk is not readily apparent. In terms of target value and in view of the relatively late deployment of the SA-2 system there, Yuzhno-Sakhalinsk does not appear to be a high-priority target area. The deployment of the Tallinn system on Sakhalin Island may reflect Soviet intentions to deploy the system at several other target areas of similar priority or may represent the start of forward defenses for the Far East mainland. In either event a higher force level projection is indicated.

23. In addition to the accelerated rate of construction starts this year, the progress noted at some of the complexes started in 1967 suggests an effort to reduce the time between initial construction and an operational capability for a complex, which now runs about two years. A shorter

construction time of about 18 months will probably apply to the new complexes and those planned for the future. The increase in the rate of construction starts and the possible shorter construction time per complex probably reflect the momentum which the Tallinn system deployment has received by the development of all the inputs, such as production facilities and personnel training, which are needed to bring the system to full operational deployment.

24. On the basis of the identified Tallinn system deployment patterns and analogy with the SA-2 system deployment program, it is believed that the ultimate force level will be about 100 Tallinn system complexes, comprised of about 310 launch sites (see Figures 1 and 5). This represents an increase of about 30 percent over previous projections, which were based on a wider separation between complexes. If the recent start rate of about 25 complexes per year is sustained, and the construction time per complex is reduced to about 18 months, the last complex in such a program would be under way by the end of 1969, and deployment of the entire operational force would probably be completed during 1971. A more extensive deployment, including a barrier defense for the Kazakh border and several lower priority target areas, would require about 140 complexes representing about 430 launch sites. This program could be completed by 1973.

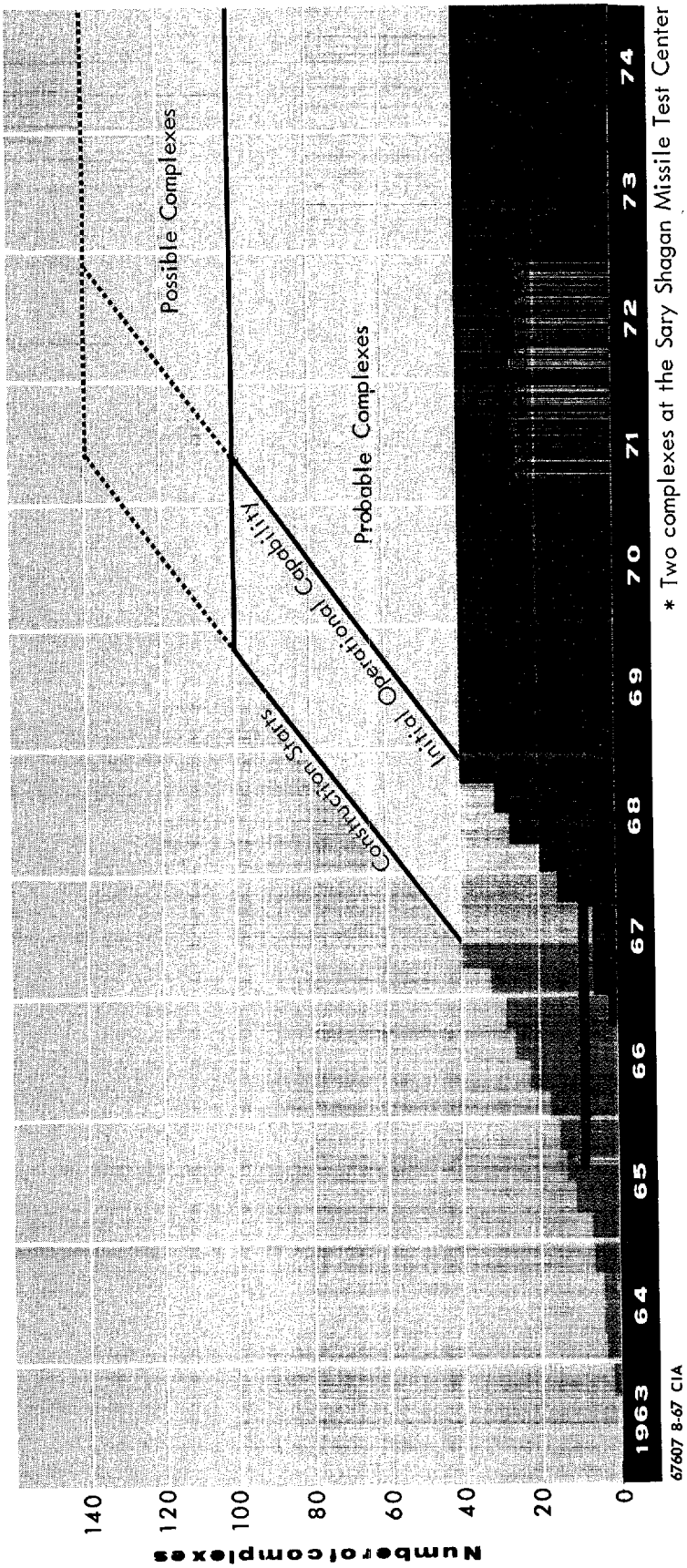

Figure 5. Tallinn System Deployment Program

[redacted]